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World Wind Energy Association

Fostering Renewable Energy Development in Sindh:

Identification of Impediments and the Road Ahead



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About the WWEA

The World Wind Energy Association (WWEA) is an international non-profit organisation headquartered in Bonn, Germany. It works in cooperation with various governments and international agencies to promote wind energy uptake worldwide. It has a network of associates in more than 100 countries. These include developed and developing economies. WWEA has assisted many governments and multilateral organisations in developing effective policies to promote renewable energy technologies.

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Fostering Renewable Energy Development in Sindh:

Identification of Impediments and the Road Ahead



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Executive Summary

Study Findings

Four main barriers are hampering renewables' growth in Sindh

Weak Grid Infrastructure: Weak grid infrastructure is the most pressing issue restraining the growth of renewable energy in Sindh. Continuous tripping and forced shut-downs are frequent for operational projects. Under construction projects are being delayed due to insufficient evacuation facilities.

Limited Ability of Provincial Government: Power system in Pakistan is centralised where the entities under the federal government have a monopoly over power evacuation, offtake and distribution. The provincial government has not been able to develop an institutional setup that deals with power purchase and distribution.

Lack of Coordination Mechanism: Policymakers at both levels have failed to develop consistent and coherent operating procedures and power procurement plans based on the existing policies. More than 2,500MW of LOIs issued by Sindh government are not included in NTDC's grid development plan as they were issued without the involvement of the grid operator.

Inconsistent Regulatory and Policy Decisions: Arbitrary decisions by the federal government have significantly slowed the progress of renewable energy in Pakistan. In 2017, the Cabinet Committee on Energy stopped renewable energy projects, including the ones initiated by Sindh under the feed-in-tariff framework. In contrast, coal and RLNG-based plants were allowed development.

The responses from the government officials remain measured and divided. The officials at the federal level see significant progress in terms of renewable energy deployment and believe bottlenecks are being removed gradually. However, respondents from the provincial government contend that more renewable energy could have been added if the previous government at the federal level had not made lopsided policy decisions.

Key Recommendations

Policy Options for the Government

- The government of Sindh should formulate an ambitious renewable energy policy, in line with its mandate and as far as possible consistent with the policy of the federal government, to demon-

strate a political commitment for the development of renewables.

- STDC should involve private investment in transmission infrastructure to avoid roadblocks to grid availability and stability for renewable energy projects. It will also reduce requirements from the provincial government's end to mobilize public funds for grid infrastructure.
- SEPCO and HESCO should be broken into smaller units for them to be managed effectively. Both federal and provincial governments should work jointly in the presence of independent boards until a formula is agreed for the devolution of DISCOs to the provincial control.
- Council of Common Interests is the right forum which should act proactively for enhanced coordination between the federal and the provincial government on renewable energy policy, planning, and development.
- The massive build-up of coal power projects in Thar requires reconsideration as it will worsen air pollution, increase capacity payments, add surplus capacity, and limit the growth of renewables which are already the most cost-competitive source of power in Pakistan.

Proposed Actions for Development Partners

- Development partners should mobilise financial and technical resources for capacity building for public and private sector working in the renewable energy sector of Sindh while also helping the provincial government in formulating renewable energy policy.
- Sindh has more un-electrified villages than any other province in Pakistan. The provincial government should seek the help from development partners to devise universal access to electricity plan relying on renewable energy.

Section A: Study Context

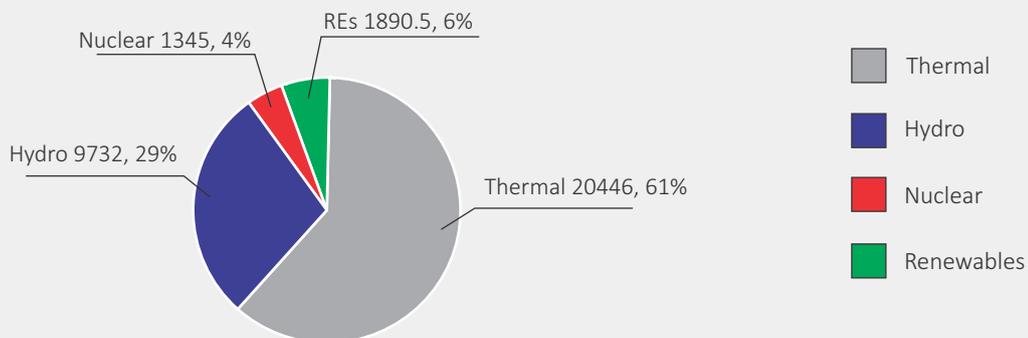
Overview of Power Sector in Pakistan

As of December 30, 2018, the total installed capacity of Pakistan stands at 36,297MW out of which 33,413MW is connected to the system of National Transmission and Despatch Company (NTDC) and 2,884MW to Karachi Electric's, a vertically integrated power utility company. Power mix of NTDC system is dominated by

20,446MW thermal generation capacity that includes natural gas, residual fuel oil, coal and high-speed diesel projects. Other sources include hydropower, renewables (wind, solar and bagasse) and nuclear having installed capacity of 9,732MW, 1,890MW and 1,345, respectively (Figure 1).

Figure 1: Pakistan's Installed Power Generation Mix

Source Wise Installed Capacity and Percentage Share



Source: NTDC

Over the past five years, significant generation capacity has been added to meet the electricity demands of the country. The induction of more than 12,000MW over the last three years seems to have averted an acute power shortage crisis that the country was facing in the previous decade. Although significant progress has been made in terms of capacity additions in the power sector, little attention was given to transmission and distribution systems. Latest capacity additions of coal-fired and re-gasified liquefied gas (RLNG) based projects will compound sustainability of the power sector of Pakistan.

Nearly 8GW of coal and RLNG power plants, made operational in recent years, will significantly increase Pakistan's greenhouse gas (GHG) emissions. The energy sector in Pakistan is already the most significant source of GHG emissions, contributing approximately 51 per cent of the total emissions of which power sector has the largest share (Chaudhry &

Sohail, 2013). Electricity prices have been rising mainly due to capacity additions of coal and RLNG projects, and conditions set under the latest bailout plan of International Monetary Fund (IMF) that requires the government to remove power sector subsidies.

The average per kWh power purchase price increased by 16 per cent in 2019 compared to the price in 2016 (Report on the Power Sector, 2020). Furthermore, the average supply cost of electricity is expected to grow by 10 per cent if 17GW of planned capacity is added in the coming six years (Chaudhry, Farooq, & Chaudhry, 2020). The capacity component is projected to be more than the energy component in the weighted average cost of generation (Figure 2). The circular debt has surged to PKR 1.8 trillion, putting the sustainability of electricity sector under question (Dawn, 2020). The country's GDP growth that was already under stress, contracted by 0.38 for the first time in 68 years after

¹ Capacity component refers to the fixed payments that a power plant receives due to its ability to produce power and not to the power produced.

² Energy component refers to the operating of electricity produced and delivered to the power purchaser.

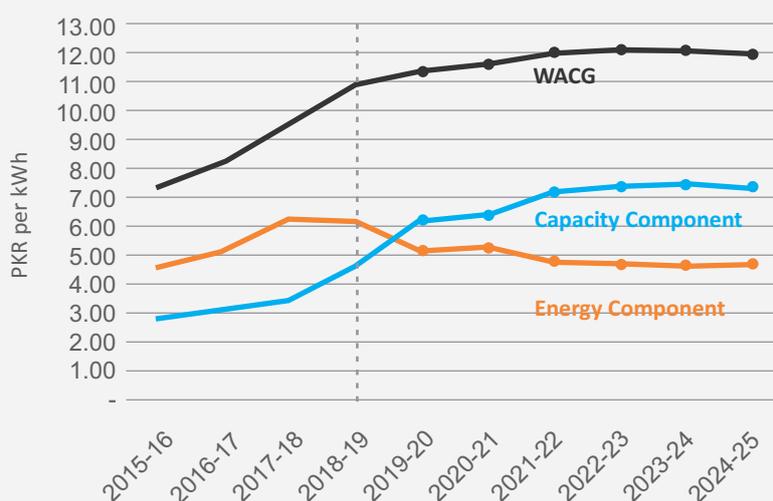


the COVID-19 crisis (Rana, 2020). The government has set a GDP growth target of 2.1 per cent, which seems to be quite ambitious when the impact of COVID-19 on the economy is unknown (The New York Times, 2020). Despite the peak demand season, power demand has dipped by 28 per cent in June 2020 in comparison to the same period last year. Amidst the recent slowdown, Pakistan is planning to double its generation capacity by 2025 most of which comes from hydro and coal-fired projects.

On the positive side, the federal government issued Letters of Support (LOS) to 11 wind projects of 558MW of which ten projects achieved financial close on 19th

November 2019. Another LOS was issued to a 50MW wind project that had completed financial close in June 2019. The tariff for these projects ranged from 4.6 to 4.8 US cents per kWh, showing a significant reduction compared to 10.5 cents per kWh in 2015 (Dawn, 2019). On the negative side, the wind power projects connected to the grid face financial difficulties due to unprecedented shutdown. The power from wind power projects located in Jhimpir is being curtailed notwithstanding their “must-run” status under the renewable energy policy of 2006. It is not easy to understand why the government continues to buy power from coal and RLNG projects and stops the offtake from renewable energy projects.

Figure 2: Projection of Weighted Average Cost of Generation



Source: Energy Institute, LUMS

The costs of renewable energy projects are declining drastically in Pakistan. Tariffs determined by the National Electric Power Regulatory Authority (NEPRA) demonstrate that wind and solar are the lowest cost form of generation in the country. A recently determined tariff by NEPRA for solar power project at 3.76 US cents per kWh makes solar power the cheapest electricity source to be added to the national grid (NEPRA, 2020).

In a significant development, the government, keeping in view the global trends, plans to announce the new renewable energy policy. The federal cabinet has already approved the draft policy document which now needs final approval from the Council of Common Interests (CCI), an apex body comprising the

federal and the provincial governments. The policy sets a target to achieve 20 per cent renewable energy capacity by 2025 and 30 per cent by 2030 in the power mix of Pakistan. Almost all renewable energy projects will be set up in different provinces. Therefore, their role becomes significant in achieving the targets set in the draft Alternative and Renewable Energy (ARE) Policy 2019.

A number of unresolved matters between the federal and the provincial government of Sindh (GoS) have been delaying the approval of ARE Policy 2019. The issues range from lack of consultation, the role of the province in initiating projects to the future of projects under development.

Renewable Energy in Sindh

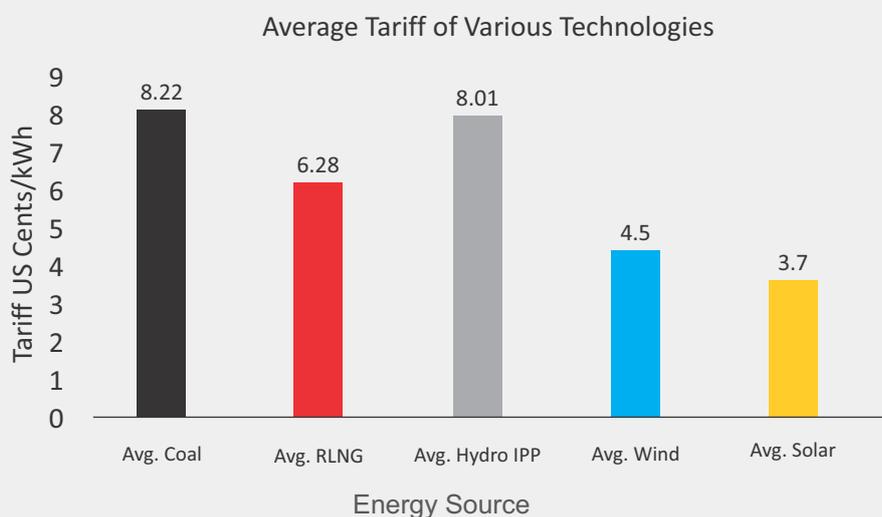
The case in perspective is the province of Sindh that holds promising renewable energy potential, particularly in the form of wind and solar resources. The Jhimpir-Keti Bandar wind corridor alone has a wind power potential of 11GW. Availability of sizeable barren land and presence of sound solar radiation makes the province ideal for utility-scale solar power generation. More than 70 per cent of the total operational wind and solar projects in the country are located in Sindh. All the grid-connected wind power projects of 1,240MW capacity in Pakistan are in the province. The GoS initiated many wind and solar power projects under the tripartite arrangement with the Alternative Energy Development Board (AEDB), of which 11 wind projects of 560MW capacity have achieved financial close. These projects are expected to become online by December 2021.

The GoS has taken some remarkable steps for the development of renewable energy in the province. By adopting the 2006 Renewable Energy Policy of the federal government, the provincial government announced the “Sindh Land Grant Policy for Renewable Energy Projects 2015” to facilitate investment in the renewable energy sector by offering favourable lease agreements for 30 years. With the support of the World Bank (WB), the GoS also plans to develop 400MW of solar projects by 2021. The joint project with WB consists of market segments, including utility-scale as well as distributed generation and

household level solar photovoltaic (PV) projects. Moreover, Sindh is set to become the first province to move towards solar energy auctions by inviting bids for a 50MW project (The News, 2019). Sindh is also the first province to develop a transmission company. Sindh Transmission and Despatch Company (STDC) has been granted a license by NEPRA to operate as a provincial grid company. STDC will complement the work of NTDC and evacuate power generated through wind and solar energy projects in the province.

While the GoS is facilitating the development of renewables, it is also leading the efforts to develop a large capacity of coal-fired projects in the province. As of early 2020, Pakistan has 5,090MW of coal-based power projects operational out of which 2,250MW, representing 44 per cent of the existing coal power capacity, are already located in Sindh (Myllyvirta, 2020). A cluster of another nine projects totalling 3,700MW is under development in the Thar region of Sindh. These projects are larger in size, and their development is complicated due to deep coal seams and limited water availability. Moreover, the impact on local communities and the environment will be hazardous (Myllyvirta, 2020). In contrast, renewable sources of energy, such as wind and solar, are environment-friendly and affordable. Renewable energy, including wind and solar, is already the cheapest option of power generation in Pakistan (Figure 3).

Figure 3. Tariff Comparison of Electricity Generation





18th Constitutional Amendment and Sindh

The National Assembly passed the 18th Amendment to the Constitution of Pakistan (after this referred to as 18th Amendment) on 8th April 2010. It aimed to move the structural affairs of the country from a mainly centralised to a mostly decentralised federation. It gives provinces the authority to regulate policy areas, including the ones linked to the electricity sector, to provide an enabling environment for its development. Sindh province—regarded as the

power hub of Pakistan with 10,050 MW installed capacity—has been the most vocal for implementation of the 18th Amendment ever since its passage by the national parliament.

Article 157 of the Constitution of Pakistan

The following is an extract from Article 157 of the Constitution of Pakistan that deals with the electricity sector:

“157. **Electricity.** (1) The Federal Government may in any Province construct or cause to be constructed hydro-electric or thermal power installations or grid stations for the generation of electricity or lay or caused to be laid inter-Provincial transmission lines [:]

Provided that the Federal Government, prior to taking decision to construct or cause to be constructed, hydro-electric power station in any Province, shall consult the Provincial Government concerned.]

2. The Government of any Province may —

- a) to the extent electricity is supplied to that Province from the national grid, requires supply to be made in bulk for transmission and distribution within the Province;
- b) levy tax on the consumption of electricity within the Province;
- c) construct power houses and grid stations and lay transmission lines for use within the Province and;
- d) determine the tariff for distribution of electricity within the Province

3. In case of any dispute between the Federal Government and Provincial Government in respect of any matter under this article, any of the said Governments may move the Council of Common Interests for resolution of the dispute.”

Before the introduction of the 18th Amendment, electricity was a federal subject. However, the passage of the amendment clearly outlines a mandate of the provinces regarding power generation, transmission, and distribution under article 157. Provinces can build power stations, and construct grids and transmission lines on their own within their territories and for their use. They can also determine tariffs for power distribution exclusively in their territorial limits.

Similarly, provinces can build renewable energy projects and connect them to the national grid. And if they desire to use power generated through renewable energy projects within their respective geographical limits, they can also set tariff for electricity distribution (Ashfaq, 2017). Under such circumstances, provinces are required to construct transmis-

sion and distribution networks on their own.

The steps taken by the provincial government of Sindh are in line with the functions devolved through the 18th Amendment. However, the absence of consumers who buy, and pay for electricity used does not permit the provincial government to make decisions entirely on its own on renewable energy development. Although power distribution companies that sell power to electricity consumers have independent boards, they still operate under the umbrella of the Power Division of the Federal Ministry of Energy without any involvement from the provincial governments. Moreover, a lack of effective coordination between the federal and the provincial governments on policy and infrastructure development issues have impeded renewable energy deployment in Sindh.

Purpose of the study

The study aims to assess the renewable energy landscape of Sindh province and the role it can play in achieving renewable energy targets set under the draft ARE Policy 2019. Another purpose is to analyse the power devolution mechanism chalked out in the 18th Amendment to the Constitution of Pakistan regarding renewable energy development with a focus on Sindh. Currently, several bottlenecks confine the deployment of wind and solar power projects in Sindh. The study not only identifies the nature and intensity of impediments to renewable energy growth in the province but also assists policymakers to make more informed decisions.

The study highlights the importance of participatory policymaking and follows an inclusive approach by consolidating responses of both public and private sector officials, thus offering a broader perspective. It provides a platform to the private sector to give its perspective both for barrier identification and for proposing policy solutions to overcome those difficulties. Often the governments in Pakistan, both at the federal and the provincial levels take decisions without involving various stakeholders. This study also aims to bridge that gap.

In conclusion, the study proposes policy solutions for the government of Sindh to foster renewable energy deployment. Besides, it also highlights some priority areas of action for development agencies to assist the provincial government for the expansion of renewable energy technologies.

Methodology

The study provides qualitative, and some fundamental quantitative analysis of data gathered through primary and secondary sources. Private renewable energy project developers and public officials in the federal government and the government of Sindh were contacted. Through in-person interviews, responses were gathered from higher management of renewable energy developers in Sindh depending on their availability and public officials based on their

willingness to participate in the survey.

After preliminary meetings with renewable energy experts, the following four barriers posing a severe threat to renewable energy development in Sindh were identified:

- the limited ability of the provincial government
- lack of coordination mechanism
- weak grid infrastructure
- policy and regulatory frameworks

The private sector respondents were asked (Questionnaire annexed) to ascribe risk score to the barriers from a scale of 0-4, keeping in view the assumptions:

Risk Score	Risk Level
0	Non-existent
1	Existing but insignificant
2	Moderately risky
3	Highly risky
4	Very highly risky

Building on the previous studies on the renewable energy market of Pakistan by WWEA, the technique has been borrowed from a study by the World Bank that asks preferences of private infrastructure investors about various factors (Lamech & Saeed, 2003). Once the risk score was assigned, respondents were asked open-ended questions seeking feedback on mitigating tools to overcome respective barriers. The public officials were asked only to reflect on challenges to renewable energy promotion in Sindh and ways to support the growth.

For this study, the risk score of each barrier was calculated based on the data collected.

³ <http://documents.worldbank.org/curated/en/272751468762026583/pdf/280910InvestorsPaper0EMSONo6.pdf>



Section 2: Findings and Discussion

Private Sector Response

The perspective of the private sector comprises a qualitative as well as a quantitative analysis based on the survey conducted. Nine senior officials managing existing and planned renewable energy projects in Sindh province were interviewed to collect responses. The result of the survey and risk scores assigned to various impediments is summarised below:

Limited Ability of the Provincial Government

The obstacle relates to the ability and lack thereof of the provincial government when it comes to facilitating the development of renewable energy projects. It includes not only a lack of institutional arrangement and expertise in the province but also a lack of financial control and resources possessed by the Government of Sindh. The power system in Pakistan is centralised, where the entities under the federal government have a monopoly over power evacuation, offtake, and distribution. The provincial governments have not been able to develop an institutional setup of the power sector that can deal with power purchase and distribution. Foreign investment is mainly channelised through the federal government that limits the role of governments at the provincial level to attract foreign investment directly.

The risk scores assigned to this barrier indicate a mix response. However, with an average response score of 3.2, it is still categorised as a highly risky obstacle that poses significant impediments to the progress of renewable energy in Sindh province. Four out of nine respondents have rated limited ability of the provincial government as a high-risk barrier. A majority of the respondents believes that the provincial government can initiate the facilitation of renewable energy projects within its territory; it still lacks institutions such as transmission and distribution networks which are under the control of the federal government. A lack of control over such entities does not permit the provincial government to support the full development cycle of renewable energy projects on its own. It was also pointed out that a lack of power to regulate the limit of sovereign

guarantee is another issue that can impede renewable energy development in Sindh. The projects involving foreign investment and financing, and which cost more than PKR 10,000 million get their sovereign guarantee determined by the Executive Committee of the National Economic Council (ECNEC). It is understood that the previous issues can severely impact renewable energy development in Sindh.

Lack of Coordination Mechanism

In the context of this study, a coordination mechanism is referred to a consistent, coherent, and comprehensive implementation and communication framework for formulating plans and implementing policies among the federal and the provincial governments. Out of nine respondents, three each ranked lack of coordination either as very high risk or highly risky bottleneck to renewable energy development in Sindh, resulting in an average score of 3.1. Coordination between various line departments within the power sector at the federal and the provincial level is weak. Policymakers at both levels have failed to develop consistent operating procedures and power procurement plans based on the existing policies. Two developers who rated it extremely risky noted that without proper coordination, the renewable energy sector could not grow at all.

The energy department of the Government of Sindh issued LOIs to many private investors to develop wind and solar projects based on feed-in-tariff. Later, the federal government decided to abandon the feed-in tariff regime and introduced auctions for power generation which delayed and, in some cases, stopped development of renewable energy projects in Sindh. Moreover, over 2,500MW of LOIs issued by GoS are not included in NTDC's grid development plan as those LOIs were issued without the involvement of the grid operator. The draft renewable energy policy sets a target to achieve 30 per cent renewable energy in the power generation mix of Pakistan by adding roughly 18,000MW by 2030. The updated Indicative Generation Capacity Expansion Plan (IGCEP) prepared by NTDC includes the same target in various demand forecast models until 2030. It is essential to mention here that the IGCEP decreases the share of renewable

to 14 per cent by 2047 from a higher share of 30 per cent in 2030 (NTDC, 2020). Such projections contravene the spirit of the policy as the future percentage should be a lot higher than the proposed one.

The present status of feedback received from private developers suggests that a comprehensive coordination mechanism has to be devised at different levels of government to scale up renewable energy deployment. Otherwise achieving the targets of new renewable energy policy will be extremely difficult. Instead of working in silos, entities operating in the federal and the provincial governments should complement each other's efforts on power planning and development, and facilitation to the private sector.

Weak Grid Infrastructure

Weak grid infrastructure seems to be the most pressing issue restricting the growth of renewable energy in Pakistan. With an average score of 3.5, all the respondents have categorised this barrier either at very high risk or high risk. It reflects the graveness of the problem. The respondents include both the developers whose projects are already connected to the grid and those developing them but facing delays due to unavailability of evacuation facilities. Interconnection facilities are not sufficient enough to offer power evacuation throughout the year. Forced shutdowns of plants and continuous tripping are common that pose difficulties in the smooth functioning of the power plants.

A group of developers whose projects have achieved financial close highlighted that their plans would be delayed by another six months due to unavailability of grid connection on time. A couple of developers argued that the Sindh government had made a right move by creating the provincial transmission company. However, it does not possess any consumer base to whom the evacuated power can be sold as the transmission network, and distribution companies work under the control of the federal government.

The private sector perspective does not present an encouraging picture of grid infrastructure in the country. The federal government has made significant progress on power generation. However, little has been done on transmission and distribution

fronts. The situation has become alarming for wind energy projects in Jhimpir due to limited and in some instances, no off-take in December 2019 (Dawn, 2019). Meanwhile, the government continued to buy power from thermal power projects citing their proximity to load centres and smooth functioning compared to wind energy projects. The worrisome situation is expected to shake investors' confidence who plan to inject significant investments in the renewable energy sector of Pakistan in general and Sindh in particular.

Inconsistent Regulatory and Policy Decisions of the Government

Stable policy frameworks are instrumental in encouraging the development of renewable energy projects through private investment. Although the Renewable Energy Policy 2006 laid down the foundation of renewable energy development in Pakistan, developers have not welcomed many government decisions taken in the past and recently. The respondents have a divided opinion regarding abrupt changes in policy and regulatory frameworks with an average response of 2.7. Some developers believe that government policies lack consistency and often endanger not only the implementation of renewable energy projects but their commercial viability too. One project developer thought that the installation of over 1.5GW renewable energy projects indicates that the policy mechanism has been reasonably stable. He argued that the project developers had failed to cope with changing market conditions at various levels of renewable energy market development.

In 2017, the Cabinet Committee on Energy decided to stop further renewable energy projects under the feed-in-tariff framework. By that time, GoS had already issued LOIs of around 2,900MW of renewable energy projects. This sudden policy shift at the federal level completely stopped renewable energy deployment in Sindh. The decision was later reversed in February 2019. However, the projects had already been delayed by 3-4 years. A project developer communicated that his company no longer planned to invest in the wind market of Pakistan due to ad hoc policy decisions.

Comparative Analysis of Barriers

It is imperative to make a comparative examination of the identified barriers after analysing them individually.

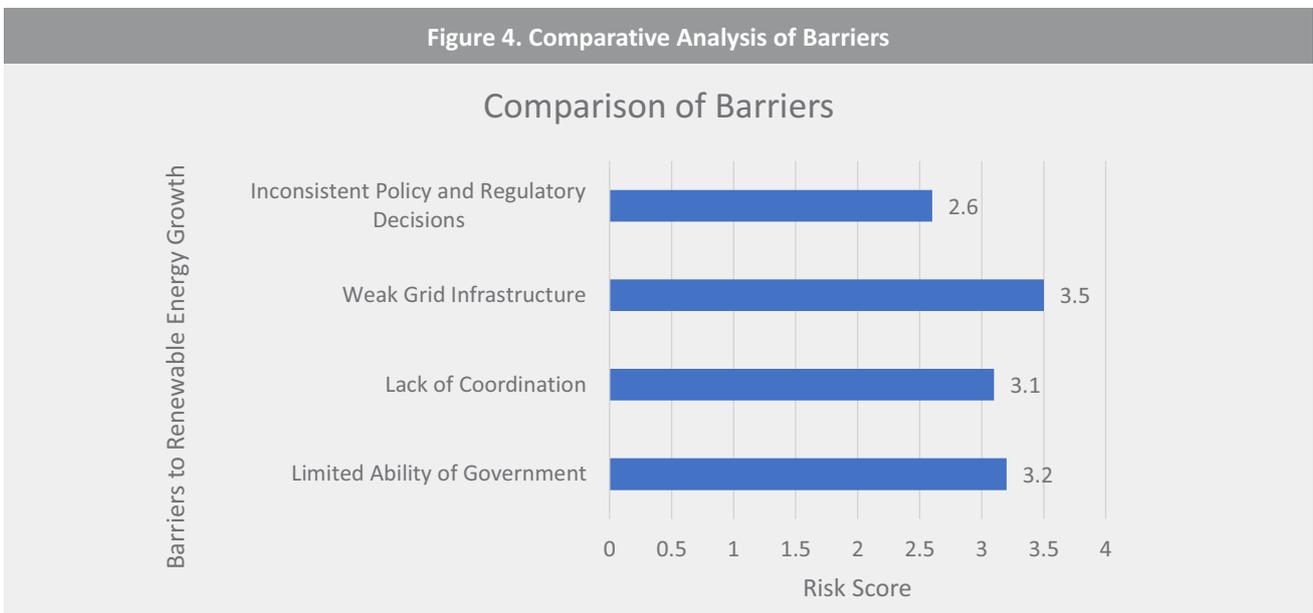


Figure 3 presents an overview of the analysis. Before making a relative comparison, the average mean of risk scores of all the obstacles is calculated. This strategy assists policymakers in setting priorities while taking mitigation actions and allocating resources. The figure shows that grid infrastructure and inadequate evacuation facilities are the most severe challenge hindering renewable energy deployment in Sindh. An average risk score ascribed to weak grid infrastructure is 3.5, indicating a very high risk. It is highly probable that without overcoming grid issues, the renewable energy market will not grow in Sindh. This barrier is followed by the limited ability of the provincial government and lack of coordination

between the federal and provincial governments. The average risk scores of these barriers are 3.2 and 3.1, respectively. The score can be interpreted as critical enough to hamper the growth of the renewable energy sector in the province.

Policy and regulatory frameworks have been identified as less risky compared to other barriers. However, it has the potential to present a significant impact on the market growth of renewables in Sindh. Having a stable policy and regulatory framework is a prerequisite for accelerating renewable energy deployment. The next section proposes measures for facilitating the progress of the same in Sindh.

Figure 4. Comparative Analysis of Barriers



Public Sector Response

The public sector response on the slow growth of renewable energy in Sindh has been divided and measured. It is noteworthy to mention that public officials were reluctant to offer their views openly. Nevertheless, respondents from government entities included, officials from the federal and the provincial governments representing AEDB, NTDC, Sindh Energy Department, STDC and the NEPRA.

Government officials were asked open-ended questions to reflect on the roadblocks to renewable energy development in Sindh. While agreeing with the notion of the slow progress of renewables in Sindh, AEDB officials believe that the delays in project completion are mainly due to the inability of the provincial government to take the federal

government on board before issuing LOIs to investors. Efficient governance of the power sector requires a coordinated effort on the part of both governments, working hand in hand for the promotion of renewable energy. It is argued that the upcoming auctions for wind power projects in Sindh are an indication of the federal government's resolve to facilitate renewable deployment in Sindh.

Provincial government's officials contend that the 18th Amendment devolves powers to the provinces to develop electricity projects, including through renewable energy sources, on their own. In their view, aggressive policies of the provincial government have made Sindh the renewable energy leader in the country. The joint project with the World Bank to install 400MW of solar PV by 2021 is an indication of the transformation from a passive responder to

unsolicited projects to a proactive player in the development of renewable energy projects in the province.

Respondents from NEPRA and NTDC agree that the slow progress of renewable energy projects in Sindh can be attributed to the inability of renewables to offer cost-effective options when the country was facing a severe power crisis. Now that the prices are going down rapidly, renewable energy will be the most cost-competitive solution for further power generation. NTDC is also critical of the intermittent

nature of renewable energy projects and their unavailability close to load centres. STDC believes that the system operator at the national level is struggling to manage renewable energy penetration in the grid effectively. Continuous tripping and forced shutdown of wind power projects in Jhampir are frequent, which are counterproductive to bringing in more investments for renewable energy development in Sindh. Since the grid operations will be more decentralised in the future, STDC can help resolve issues faced by renewable energy projects in Sindh.



Section 3: Policy Implications

Capitalising on the findings of the study and the market perspective from respondents, both public and private, this section intends to assist the policymakers involved in the development of renewable energy sector in engineering policy tools that can manoeuvre the market towards a positive direction. The lessons drawn offer an insight not only to the policymakers in Sindh but also to their counterparts in the federal and other provincial governments. Policy lessons are equally crucial for the development partners working for the promotion of renewable energy.

Policy Options for the Government

Provincial Renewable Energy Policy

While the federal government needs to unleash the potential of renewable energy resources, the provincial government must take responsibility for a low-carbon future by developing proactive policy measures to harvest the renewable energy potential in Sindh. Such policy measures should include devising economically feasible solutions, fostering technological innovation and engaging the private sector for renewable energy generation in the province. As Sindh holds the key to achieve targets set by the federal government in new renewable energy policy, the provincial government, depending upon its mandate, should announce its ambitious goals to demonstrate political commitment.

Policies at a regional and subnational level have been quite instrumental in the expansion of renewable revolution throughout the world. Around half of the renewable energy growth in the United States of America can be attributed to state renewable energy policies and requirements since 2001 (NCSL, 2020). The State of California is a prime example as it is home to some of the largest renewable energy projects. India has also been successful in deploying renewable energy projects at a massive scale due to dedicated policies at the state level. States of Karnataka, Gujarat, Andhra Pradesh, and Tamil Nadu have been leading the efforts for renewable energy development through state-level strategies and with support from the central government (Verma, 2020). Keeping in view the international best practices, Sindh should devise a comprehensive renewable

energy policy that includes the development of renewable energy at utility-scale, commercial, residential, and off-grid areas. The implementation of Sindh Solar Energy Project with the help of the World Bank is a good beginning, but such efforts cannot replicate a broader policy framework.

The 18th Amendment to the constitution empowers provinces to generate, transmit, and distribute electricity on their own within their territories. Moreover, they can determine the tariff for distribution of electricity. Keeping in view the devolution formula, the government should prioritise the following actions under the proposed renewable energy policy:

- a) *Setting targets:* A possible way of achieving a higher share of renewable energy is to set time-bound and well-defined targets. Sindh should instead aim at higher penetration of renewables than the one envisaged by the federal government due mainly to wind and solar resource availability in the province, and its experience and readiness when it comes to renewable energy development.
- b) *Combining special economic zones with renewable zones:* Special economic zones in different provinces, including Sindh, are also among the essential features of Phase 2 of the China Pakistan Economic Corridor (CEPC). Apart from the one being developed under CEPC, the government of Sindh plans to create several economic zones in the province. For that purpose, the Sindh Economic Zones Management Company has also been established. The establishment of economic zones will increase the electricity demand in the province. To meet the power demands of industrial economic zones, the provincial governments should create renewable energy zones in proximity to economic zones. Such a practice will partly alleviate concerns that renewables cause difficulties for grid operations due to variable nature and distance from load centres as the power generated in renewable energy zones will be utilised in the adjacent economic zones. The provincial government should ensure social, economic, and environmentally equitable development of such zones by making local inhabitants part of the development plan.

- c) *Local manufacturing:* The new renewable energy policy by the federal government encourages domestic production of renewable energy technologies (RETs). Such manufacturing of RETs will spur local industrial growth and create new job opportunities. The government of Sindh should seize the opportunity by devising a strategy for domestic production of RETs as part of its renewable energy policy. The private sector can be provided financial and fiscal incentives for establishing manufacturing units within the special economic zones that are already being created in the province. Moreover, domestic investors should be allocated special quotas while establishing manufacturing units as they play an important role in a building a national supply chain.
- d) *Distributed generation and rural electrification:* NEPRA's net-metering regulations provide a promising opportunity for a distributed generation, but the progress has been slow throughout the country. In a positive development, the provincial government of Sindh plans to add 20MW of distributed solar PV on public buildings under the Sindh Solar Energy Project. The plan should also be expanded to residential and commercial areas and should be made part of the renewable energy policy of the province. With only 66 per cent electrification rate, Sindh has the highest number of un-electrified villages in Pakistan. It seems that the policymakers have a bias to promote the extension of the national grid, keeping in view the political mileage they might get, without assessing economic and technological parameters of available alternatives. The provincial government must establish mini-grids by involving the private sector. Renewable energy mini-grids have proved instrumental in providing basic electricity in many parts of Asia and Africa. Public resources should better be utilised for developing financing and policy tools for rural electrification through mini-grids, and special consideration should be given to community energy approaches, i.e. mini-grids owned and managed by a local community organisation.

Involving Private investment in Grid Infrastructure and Reforming Distribution Companies

The weak and insufficient grid infrastructure remains the most severe barrier confining renewable energy development in Pakistan. Creation of STDC is a step in the right direction. However, NTDC controls the transmission network in the country. STDC, owned by the government of Sindh, is well-positioned to supplement the work of NTDC mainly as the federal government plans to increase the share of renewable energy such as wind and solar in the power mix from merely 6 per cent today to 30 per cent by the year 2030. A significant capacity of wind and solar power projects will be installed in Sindh province, making the involvement of STDC even more critical. Most of the projects will be developed at utility-scale, indicating that the grid enhancement plans require reassessing by identifying transmission projects to be developed by the private sector. STDC should involve private investment in transmission infrastructure to avoid roadblocks to grid availability and stability for renewable energy projects planned for the future. It will also reduce requirements from the provincial government's end to mobilise public funds.

In the future electricity scenario where variable renewable energy penetration and distributed generation are expected to be high, the use of smart grid technologies will be quite notable. Smart grids offer an opportunity for STDC to leapfrog over old grid technologies and to improve system reliability by engaging private investment that would lower the burden on the government that is already fiscally challenged.

Reforming DISCOs

The country's ability to reach a target of 30 per cent renewables by 2030 will largely depend on the health of distribution companies (DISCOs), which are at the heart of the power market. Two DISCOs, namely Sukkur Electric Power Company (SEPCO) and Hyderabad Electric Supply Company (HESCO) supply the electricity in Sindh province apart from Karachi. In its Performance Evaluation Report of Distribution Companies for 2017-18, NEPRA observed no remark-

⁴ Net metering allows electricity consumers to generate their electricity in order to offset their electricity use.



able improvement in both DISCOs, citing geographical issues, law and order situation and some political factors (NEPRA, 2018). Both SEPCO and HESCO performed poorly in the recovery of electricity bills and in containing transmission and distribution losses. It is difficult for the federal government to run DISCOs efficiently from Islamabad. The provincial government should be engaged to improve bill recovery and curb power thefts in both DISCOs.

A coordinated effort between the federal and the provincial governments will lay the groundwork for a more proactive role by the latter in the reform process of DISCOs. Transferring full control of DISCOs to the provincial government may not be a practical solution in the prevailing situation due to disagreement on the transfer of circular debt of respective DISCOs. Therefore, SEPCO and HESCO should be broken into smaller units for them to be managed effectively. Both governments should work jointly in the presence of independent boards until a formula is agreed for the devolution of DISCOs to the provincial control.

Comprehensive Coordination Mechanism

Constitutional powers of the provincial governments, renewable energy resource availability across provinces, and the current structure of the power market in the country accentuate the need for developing a comprehensive coordination mechanism between different levels of governance. The arrangement must be designed and implemented in a participatory manner as it will help to ensure ownership of renewable energy deployment across the country.

As discussed in the previous section, whatever the cause may be, lack of coordinated efforts between the central government and the government of Sindh has delayed the development of many renewable energy projects. The roles and responsibilities of provincial and federal entities should be defined as mandated in Article 157 of the Constitution of Pakistan after the 18th Amendment. Until implemented, it would be challenging to develop renewable energy projects on the direction only from the Sindh government. Since the power sector has not been fully transferred to the province, renewable energy progress cannot be ensured without aligning the federal and the provincial targets in a coordi-

nated manner. The Council of Common Interests, with equal representation from all the provinces, is the right forum for all matters about the power policy and implementation at the national level. It is therefore essential to make use of the constitutional platform of the council to resolve differences and make decisions linked to the power sector at the national level in a participatory and democratic manner, and in consistence with the constitutional provisions.

Re-evaluating Capacity Addition through Coal

The government of Sindh needs to reconsider building coal-fired projects in the future. Apart from projects already commissioned or under construction, new ones, using both local and imported coal, must not be allowed to be developed. Large scale penetration of wind and solar call for greater flexibility of the power system, which cannot be provided by coal-fired projects. Coal Projects cannot be easily ramped up and down to complement the intermittency of wind and solar. Moreover, developing more coal power projects does not make much economic sense as tariffs of new renewable energy projects, namely wind and solar, are already the lowest in the country. The average tariffs for under-construction wind and solar power projects are US cents 4.5/kWh and 3.7/kWh, respectively.

In comparison, the average tariff of operational coal-fired projects stands at approximately US cents 8/kWh (Figure 3, Section 1). Further capacity addition of coal-fired projects may jeopardise the sustainability of the power sector as electricity demand is not growing due to economic slowdown. Adding large blocks of coal power capacity will significantly increase the circular debt, which has already ballooned to PKR 1.8 trillion. Whereas developing smaller modular blocks of renewable energy projects, proportional to power demand, will help avoid the debt problems currently plaguing the sector.

More than 2,100MW of oil and gas-based power projects operational in Sindh are going to retire by 2025 (Table 1). This gap presents an excellent opportunity for Sindh. The capacity should entirely be filled by adding low-cost wind and solar power projects to the system.

Table 1. Retirement Schedule of Existing Power Projects

Name of Power Station	No. of Units / Blocks	Unit Capacity MW	Year			
			2020	22	23	25
Jamshoro	1	200			-1	
	3	170			-3	
Kotri C.C.	1	107				-1
Guddu	2	60			-2	
Steam	2	140			-2	
Guddu	2	280			-2	
C.C.	1	360				-1

Source: NTDC

Air pollution level in Pakistan is already among the highest in the world. The massive build-up of coal-fired projects in Thar will make the region a hotspot of mercury and carbon emissions in South Asia. According to a recent study by Centre for Research on Energy and Clean Air, coal power plants in Thar will be responsible for an estimated 29,000 premature deaths over the period of 30 years besides harming the cropland significantly (Myllyvirta, 2020).

Regional and subnational governments all over the world are rolling out their plans for climate action to reach goals set in the Paris Accord of 2015. Sindh's appetite for mining coal from Thar coalfield and using the same for power projects is contrary to global trends. Such a practice not only poses asset stranding risk to the provincial government's investments in coal-fired projects but also slows the speed of renewable energy development in Sindh.

Proposed Actions for Development Partners

The benefits presented by renewable energy sources to meet global sustainability goals have convinced multilateral institutions and development partners to divert their support to renewable energy development. Subnational and regional governments have a significant role to play in this regard. Therefore, the development partners need to work directly with them to increase the use of renewable energy sources for power generation.

Policy Development: Development agencies should help the government of Sindh to develop a renewable energy policy. Instead of ad hoc project support directed for renewable energy promotion, a programmatic approach should be designed for policy development and planning for the growth of

renewables. While developing a strategy for a region, it is imperative to give due importance to local potential and requirements. It has been learned over the years that development assistance is more successful when directed towards policy advice, investment attraction, and technical support for renewable energy promotion.

Capacity Building: Another area of intervention for development partners is enhancing capacity development in the province. While assisting the provincial government in the policies and planning for renewable development, a holistic assessment of actual needs should be completed. Capacity development programmes must be implemented for all stakeholders, including public officials, private sector, and civil society, to name a few. Such initiatives optimise their outcomes when tailored following the local needs. The study suggests that development partners mobilise financial and technical resources for effective implementation of the proposed renewable energy policy in Sindh.

Rural Electrification: As discussed earlier in the study, Sindh has the highest number of un-electrified villages in Pakistan. Many of those villages and rural areas have organisational and physical, if not financial, resources available, in the form of solar and wind, to generate electricity. The small scale and distance from urban centres do not allow authorities to expand transmission infrastructure to off-grid areas. Innovation in the use of renewable energy technologies provides optimal solutions to electrify those areas. It is essential to mention here that neither the government nor the development partners would be able to mobilise resources to expand grid infrastructure for all citizens to get grid access.

Development partners can help the provincial government of Sindh devise universal access to electricity plan relying on renewable energy. It is necessary to develop market-based mechanisms and encourage smaller private sector players, including community energy organisations, to invest in renewable energy mini-grids and pay-as-you-go solar power model. Additional support should also be offered in the shape of grants where the local population cannot afford even the cheapest form of electricity, and smaller private sector players are unwilling to invest their capital.



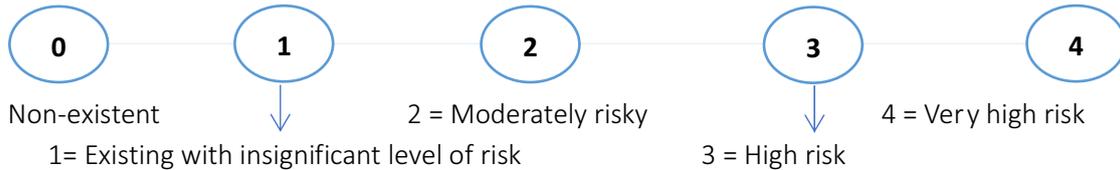
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Annexure

1. Weak Grid Integration and Interconnection Facilities

Weak grid infrastructure is often cited as a serious challenge for renewable energy development. What is your take on the ability of the grid operator and how do you rate this barrier confining renewables' progress in Sindh?



Any comments on the nature of the problem and improving the current/anticipated future situation:

2. Limited Ability of the Government:

The power sector of Pakistan is centralised in nature where the federal government controls power offtake, transmission and distribution. The government of Sindh has little control over the functions of power sector. How do you see this roadblock confining renewable energy development in Sindh?



Any comments on the nature of the problem and improving the current/anticipated future situation:

3. Inconsistent Regulatory and Policy Decisions:

Reliable, consistent, and predictable policy decisions are pre-requisite for an enabling environment to successfully mobilise private sector investments. How do you find policy and regulatory decisions taken by the government from time to time?





Any comments on the nature of the problem and improving the current/anticipated future situation:

4. Lack of Coordination Mechanism:

The coordination between different government agencies is necessary for energy infrastructure development. What score would you assign to the lack of coordination between the federal and the provincial governments?



Any comments on the nature of the problem and improving the current/anticipated future situation:



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